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| **METHODS OF SCIENTIFIC INVESTIGATION& RESEARCH** Grade 12 Foundation | | | | |
| **Planning** | | | | |
| **Standards and Aspects Assessed** | **Exceeds the Standard** | **Meets the Standard** | **Approaching the Standard** | **Below the Standard** |
| * 1. **Identification of a focused[[1]](#footnote-2)research question** | | | | |
|  | Student can formulate a focused research question and justify their choice | Student can formulate a focused research question. | Student can formulate a research question but requires help to focus the question. | Student requires help to formulate a research question. |
| **1.3 Identifying and controlling variables** | | | | |
| * **identifying** | Student can identify the influential variables and can indicate which of those are dependent and independent. | Student can identify influential[[2]](#footnote-3)variables and can indicate which of these are the independent and dependent variables. | Student can identify variables but requires help to indicate which of these the dependent are and independent variables. | Student requires help to be able to identify variables. |
| **- controlling** | Student can identify the variables that need to be controlled and say how to control them. | Student can identify influential variables that need to be controlled. | Student needs assistance to identify influential variables that need to be controlled | Student requires help to be able to identify variables that need to be controlled. |
| **1.2 Make predictions directly related to a research question** | | | | |
|  | Student makes a clear relevant predictionsupported by reference to scientific theory. | Student makes a clear4[[3]](#footnote-4)relevant3[[4]](#footnote-5) prediction and connects this with a scientific idea or theory | Student makes a relevant prediction as to what they think will happen | Studentneeds assistance to make a prediction as to what will happen |

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| **Obtaining and Processing[[5]](#footnote-6)Evidence** | | | | |
| **Standards and Aspects Assessed** | **Exceeds the Standard** | **Meets the Standard** | **Approaching the Standard** | **Below the Standard** |
| **4.1 Select and use correctly and competently the appropriate equipment and materials for an investigation, with due regard for the safety of self and others.** | | | | |
| **- selecting equipment and materials** | Student can choose correct equipment independently | Student can choose correct equipment with little help. | Student requires help and/or checking of equipment they have selected | Student requires full instruction to select appropriate equipment. |
| **- using equipment and materials** | Student can use equipment correctly without help. | Student can use equipment correctly with little help. | Student requires some help and/or checking to use equipment correctly. | Student requires full instruction to use equipment correctly. |
| * **paying regard to safety (where appropriate)[[6]](#footnote-7)** | Student is aware of potential safety issues with the investigation and plans prevention strategies | Student is aware of potential safety issues and requires little help to plan prevention strategies. | Student requires some help and/or checking to use equipment safely. | Student requires full instruction to use equipment safely. |
| * 1. **Record raw data appropriately in a manner that allows easy interpretation** | | | | |
| **- records appropriate raw data** | Student collects and records sufficient relevant data that allows the question to be answered | Student collects and records sufficient relevant data that allows the question to be answered | Student requires help to collect and record raw data that is both sufficient and relevant to the question being investigated | Insufficient raw data is collected and recorded to be able to answer the question |
| **- manner of recording allows for easy interpretation** | Raw data is recorded in a table, diagram or list of observations with correct labels, units and acknowledgment of variation in the data where appropriate | Raw data is recorded in a table, diagram or list of observations with correct labels and units | Raw data is recorded in a table or list of observations. |  |
| **3.2 Process raw data by the most appropriate means** | | | | |
|  | Student constructs and uses a variety of diagrams, charts, graphs or numerical methods to process evidence.  The processed evidence is significant to the investigation. | Student constructs and uses diagrams, charts, graphs[[7]](#footnote-8) or numerical methods[[8]](#footnote-9)to process evidence that informs the investigation(i.e. is relevant) | There is some processing of data or evidence (graphing, calculating means for example).  The student needs help to select an appropriate way to process data. | There is little relevant processing of raw data or evidence. |

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| **Conclusion[[9]](#footnote-10)and Evaluation** | | | | |
| **Standards and Aspects Assessed** | **Exceeds the Standard** | **Meets the Standard** | **Approaching the Standard** | **Below the Standard** |
| **3.3 Draw valid conclusions allowing for errors and uncertainties.** | | | | |
| **- valid conclusions** | Student states conclusions with justification based on a reasonable interpretation of the data or the processed data that is relevant to the investigation. | Student states conclusions based on a reasonable[[10]](#footnote-11) interpretation of the data or processed data.  Conclusions are relevant to the investigation | Student states a conclusion based on available data.  The conclusion may not be relevant to the investigation | Gives a conclusion that is inconsistent with the data or is irrelevant to the investigation |
| **- allows for bias[[11]](#footnote-12) or uncertainties** | Actual and potential sources of bias and uncertainty are identified | Sources of bias and uncertainty are identified | Sources of bias or uncertainties in conclusions are identified with teacher prompting |  |
| **1.5 Identifying weaknesses and developing realistic strategies for improvement** | | | | |
| **- identifying weaknesses** | Makes realistic comments about the procedure used or the evidence[[12]](#footnote-13) obtained that identifies weaknesses | Makes comments about the procedure used or the evidence[[13]](#footnote-14)obtained that identifies weaknesses | Makes uncritical comment about the procedure used or the evidence obtained | Identifies weaknesses or limitations that are general rather than specific to the problem |
| **- developing realistic strategies for improvement** | Provides practical suggestions for changes needed to improve the procedure. | Provides suggestions for changes needed to improve the procedure. | Requires help to identify any changes needed to improve the procedure. |  |

1. A focused research question is one that

   - is worth finding an answer to

   - has an answer that can be found

   - has the parameters (boundaries, limits, factors or variables) of the problem defined [↑](#footnote-ref-2)
2. Influential - a factor or variable that will have a significant effect on this investigation [↑](#footnote-ref-3)
3. Clear - means easy to read and follow [↑](#footnote-ref-4)
4. Relevant - means related to the focused research question [↑](#footnote-ref-5)
5. Processing could involve any of the following: graphs, averages, calculations, plotting, use relations in processing data, best fit line, and gradients. Graphs must include correct labels and units. [↑](#footnote-ref-6)
6. At teacher’s discretion – depends whether safety is an issue in the investigation [↑](#footnote-ref-7)
7. Graphs need to have appropriate scales with labeled axes and accurately plotted points. Any incorrectly plotted point(s) should not have a significant effect on the conclusion. [↑](#footnote-ref-8)
8. Numerical methods include the use of a formula to obtain a physical value such as a constant, gradient, trend or correlation that will inform or evaluate the data against the focused question. For Exceeds the Standard this could involve the calculation of uncertainties. [↑](#footnote-ref-9)
9. Any conclusion made must be supported by evidence and must be relevant to the focused question for “Meets the Standard” or “Exceeds the Standard”. [↑](#footnote-ref-10)
10. Reasonable – logical given the available data [↑](#footnote-ref-11)
11. Bias – used in preference to ‘error’ [↑](#footnote-ref-12)
12. For the Evaluation to Exceed the Standard it must take into account biases (systematic or random) and uncertainties that are specific to the investigation. Any comments must be more than general statements about bias or uncertainties. The discussion should suggest how to reduce any biases identified and achieve better control of influential variables. [↑](#footnote-ref-13)
13. For the Evaluation to Meet the Standard it could take into account bias (systematic or random) and evidence should come from the conclusion [↑](#footnote-ref-14)